ANALOG DEVICES

TECHNICAL NOTE

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Using the AD7740 in Isolation Applications

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INTRODUCTION

This Technical Note describes how to use an AD7740 Voltage-to-Frequency Converter in an isolated application. Due to noise, safety requirements or distance it may be required to isolate the AD7740 from any controlling circuitry. This can be easily achieved by using optocouplers, which can provide isolation in excess of 5kV.

The VFC converts the analog voltage to be transmitted, VIN, to a digital pulse train. An optocoupler circuit is used to couple this pulse train across an isolation barrier using light as the connecting medium. The input LED of the isolator is driven from the output of the AD7740. At the receiver side, the output transistor is operated in the photo-transistor mode. The pulse train is inverted and can be reconverted to an analog voltage using a frequency-to-voltage converter; alternatively, the pulse train can be fed into a counter to generate a digital signal.

The analog and digital sections of the AD7740 have been designed to allow operation from a single-ended power source, simplifying its use with isolated power supplies.

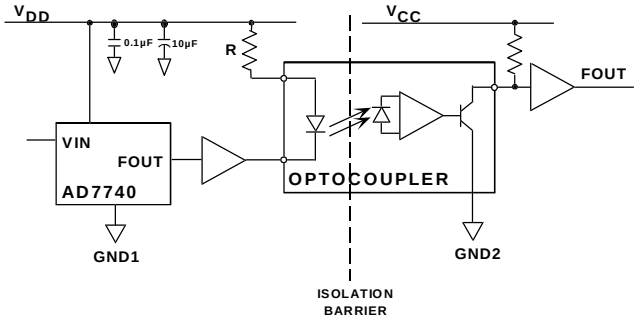

Figure 1. AD7740 in an Opto-Isolated Application

Figure 1 shows the AD7740 in an application where isolation is achieved using a logic-gate optocoupler. A +5 V power supply is assumed for both the isolated (V_{DD}) and local (V_{CC}) supplies.

When the reference pin (REFIN) is tied to V_{DD} the transfer-function of the AD7740 is:

FOUT = 0.1 CLKIN + 0.8 (VIN/REFIN) CLKIN

In low-power circuits the AD7740 is typically clocked at 32 kHz. This corresponds to an output frequency of 3.2 kHz to 28.8 kHz for a nominal input voltage range of 0 V to 5 V on VIN. Hence the optocoupler used must have rise- and fall-times which can accommodate this frequency range.

A disadvantage of this approach is that logic-gate optocouplers tend to be quite expensive. Another approach is to use some additional circuitry to speed up a cheap and slow optocoupler. By using a differential line-driver (e.g. ADM485) the maximum frequency through the optocoupler can be increased by a factor of six. See Figure 2.

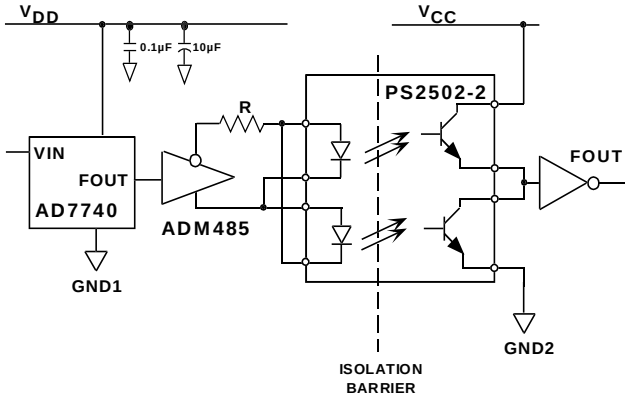

Figure 2. Using a differential line-driver to speed up an optocoupler

The scope plots in Figures 3 and 4 overleaf show that the maximum frequency through the PS2502-2 optocoupler has been increased from 5 kHz to 32 kHz by the addition of a differential line-driver. Hence this circuit can handle the full FOUT range thus providing a low-cost solution to signal isolation.

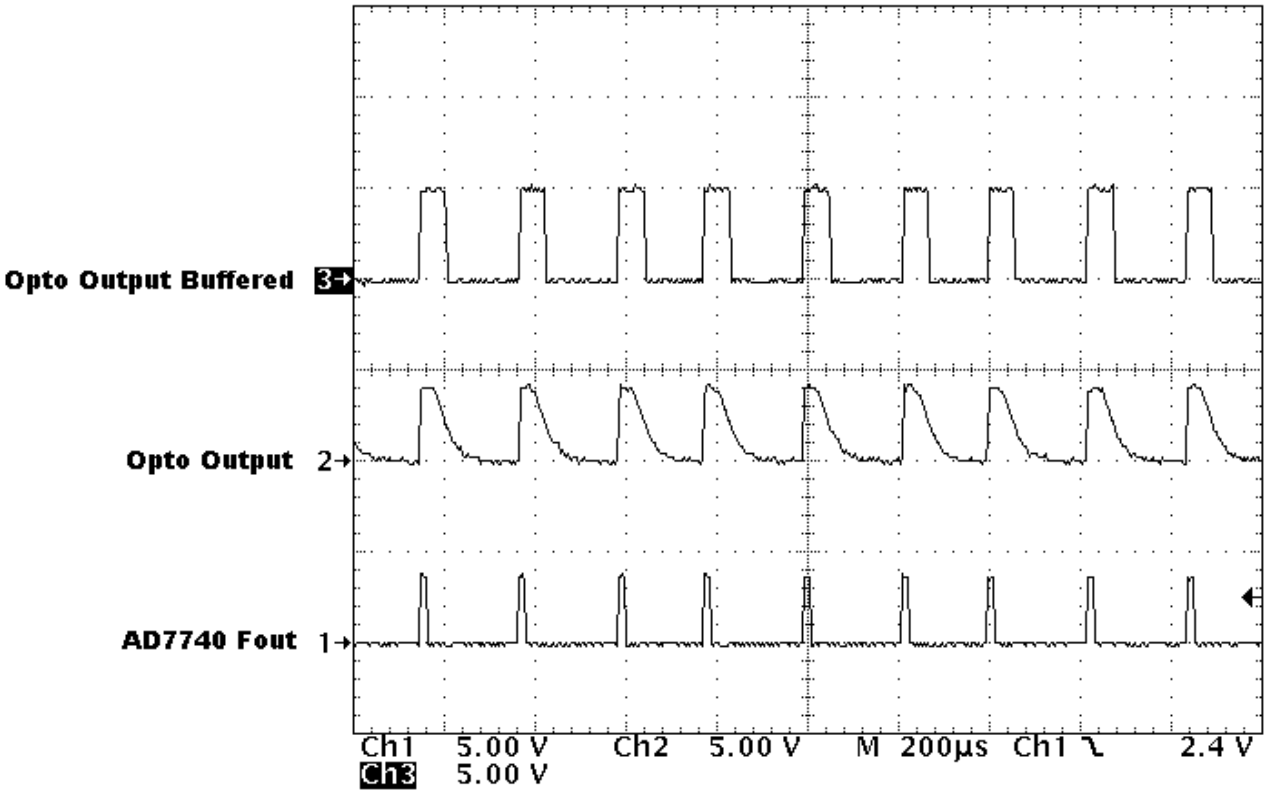

Figure 3. PS2502-2 optocoupler being driven directly by the AD7740

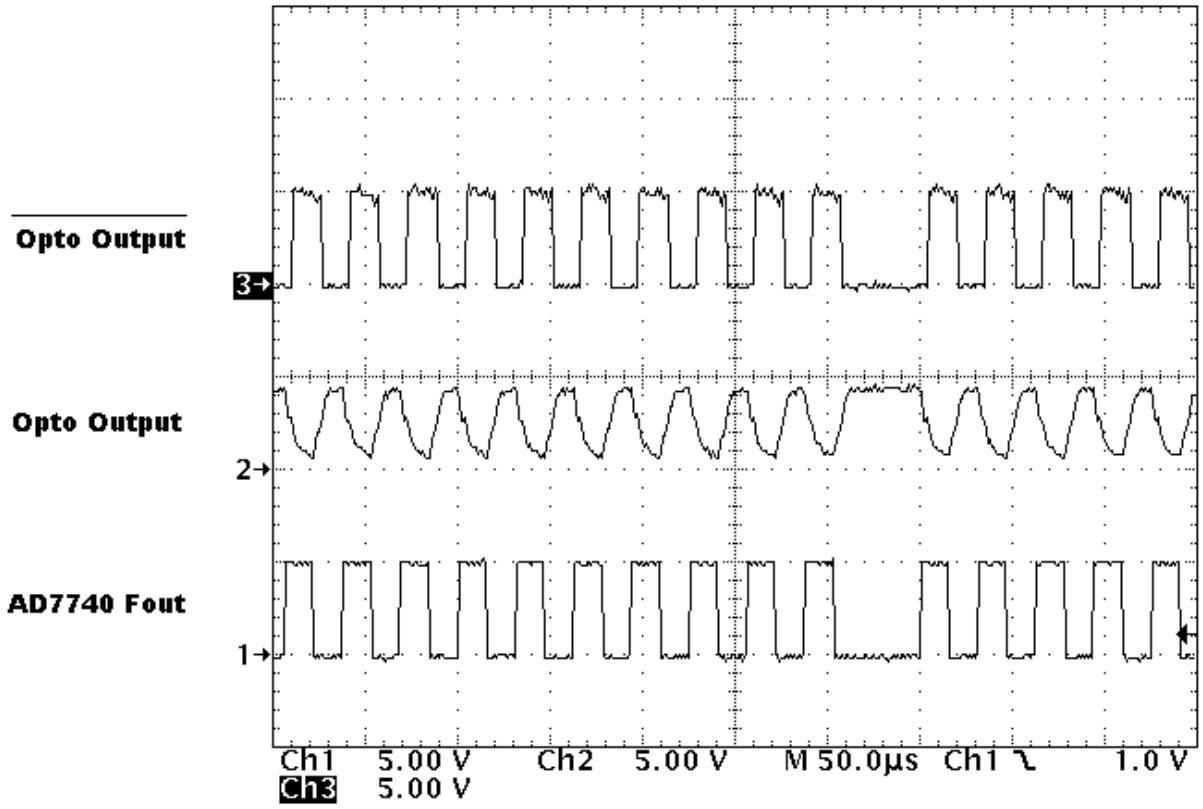

Figure 4. PS2502-2 optocoupler being driven by a differential line-driver